



NASA SBIR 2012 Phase I Solicitation

H9.01 Long Range Optical Communications

Lead Center: JPL

Participating Center(s): GRC, GSFC

This subtopic seeks innovative technologies for long range Optical Telecommunications supporting the needs of space missions. Proposals are sought in the following areas:

Systems and technologies relating to acquisition, tracking and sub-micro-radian pointing of the optical communications beam under typical deep-space ranges (to 40 AU) and spacecraft micro-vibration environments.

- *Isolation platforms* - Compact, lightweight, space-qualifiable vibration isolation platforms for payloads massing between 3 and 50 kg that require less than 15 W of power and mass less than 3 kg that will attenuate an integrated angular disturbance of 150 micro-radians to less than 0.5 micro-radians (1-sigma), from
- *Laser Transmitters* - Space-qualifiable, >20% DC-to-optical (wall-plug) efficiency, 0.2 to 16 nanosecond pulse-width 1550-nm laser transmitter for pulse-position modulated data with from 16 to 320 slots per symbol, less than 35 picosecond pulse rise and fall times, near transform limited spectral width, single polarization output with at least 20 dB polarization extinction ratio, amplitude extinction ratio greater than 38 dB, average power of 5 to 20 Watt, massing less than 500 grams per Watt. Also of interest for the laser transmitter are: robust and compact packaging with radiation tolerant electronics inherent in the design, and high speed electrical interface to support output of pulse position modulation encoding of sub nanosecond pulses and inputs such as Spacewire, Firewire or Gigabit Ethernet. Detailed description of approaches to achieve the stated efficiency is a must.
- *Photon counting near-infrared detectors arrays for ground receivers* - Hexagonal close packed kilo-pixel arrays sensitive to 1000 to 1650 nm wavelength range with single photon detection efficiencies greater than 60% and single photon detection jitters less than 40 picoseconds 1-sigma, active diameter greater than 15 microns/pixel, and 1 dB saturation rates of at least 10 mega-photons (detected) per pixel and dark count rates of less than 1 MHz/square-mm.
- *Photon counting near-infrared detectors arrays for flight receivers* - For the 1000 to 1600 nm wavelength range with single photon detection efficiencies greater than 40% and 1dB saturation rates of at least 1 mega-photons/pixel and operational temperatures above 220K and dark count rates of
- *Ground-based telescope assembly* - Telescope/photon-buckets with primary mirror diameter ~2.5 meter, f-number of ~1.1 and Cassegrain focus to be used as optical communication receiver/transmitter optics at 1000-1600nm. Produce a maximum image spot size of ~20 micro-radian, and field-of-view will be ~50 micro-radian. Telescope shall be positioned with a two-axis gimbal capable of 0.25 milli-radian pointing. Desired

manufacturing cost for combined telescope, gimbal and dome in quantity (tens) is ~\$3 M each.

Research should be conducted to convincingly prove technical feasibility during Phase I - ideally through hardware development, with clear pathways to demonstrating and delivering functional hardware, meeting all objectives and specifications, in Phase II.

Phase I Deliverables - Phase I deliverables shall include a final report describing design studies and analyses, system, sensor, or instrumentation concepts, prospective material formulations, testing, etc. Prototype systems, components, sensors, instruments or materials can be developed in Phase I as well. The designs or concepts should have commercialization potential. For Phase II consideration, the final report should include a detailed path towards Phase II hardware proof-of-concept system or component or material manufacturing and testing as applicable. The technology concept at the end of Phase I should be at a TRL of 4.

Phase II Deliverables - Phase II deliverables shall consist of working proof-of-concept systems, tested material formulations with samples, tested component, sensor, or instrumentation hardware, etc. which have been successfully demonstrated in a relevant environment and delivered to NASA for testing and verification. The technology at the end of Phase II should be at a TRL of 5-6.

Potential NASA Customers include:

- Deep Space Planetary Missions.
- Deep Space Optical Terminal (DOT) Project.
- Space Communications and Navigation (SCaN) Program.